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ABSTRACT

Canada has explored the use of satellites as a means to provide information and communications services to geographically isolated populations since 1962. Between 1972 and 1984, five series of satellites known as Anik A, B, C, and D and Hermes were launched. Each satellite provided expanded communications services, and each led to research and experiments in educational applications, some of which included joint ventures with other countries. For example, more than 20 Canadian organizations carried out technical and social experiments with the Hermes satellite, including direct-to-home television and radio broadcasting, tele-education, telemedicine, community interaction, administrative services, and native communications services. Research indicates that communications satellites far surpass their initial purpose of reaching remote populations. Current and future developments include two-way satellite technology, integration of satellites and computer assisted and managed instruction in distance education, and local and regional computer networking via satellite. Among the most important issues regarding the use of satellites for educational purposes are: (1) determining ownership and copyright of satellite programs; (2) integrating satellite educational services with existing terrestrial distribution systems; (3) determining cost-effectiveness of satellite delivered educational service; (4) evaluating student satisfaction and performance for educational services delivered by satellite; (5) establishing educational satellite consortia on a regional basis; and (6) deciding whether a satellite educational service should have one-way or two-way capabilities. (10 references) (DB)

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NEW TECHNOLOGIES IN CANADIAN EDUCATION

PAPER 12

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EDUCATIONAL APPLICATIONS OF COMMUNICATIONS SATELLITES IN CANADA

By J. Murray Richmond

Study Coordinator
Ignacy Waniewicz

June 1984

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Paper 5 Communications and information technologies and distance education in Canada

Paper 6 Communications and information technologies and the education of Canada's native peoples

Paper 7 The provincial educational communications organizations in Canada

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Paper 9 Applications of new technologies in nonformal adult education in Canada: Two examples

Paper 10 Canadian cable television and education

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Paper 12 Educational applications of communications satellites in Canada

Paper 13 Educational videodisc in Canada

Paper 14 Educational teleconferencing in Canada

Paper 15 Telehealth: Telecommunications technology in health care and health education in Canada

Paper 16 The high technology industry and education in Canada

Paper 17 New technologies in education in Canada: Issues and concerns

Copies of these papers can be purchased from TVOntario, Box 200, Station Q, Toronto, Ontario, Canada M4T 2T1.

FOREWORD

We dedicate this series to its designer and director, Ignacy Waniewicz. His death on February 21, 1984, has left us with a feeling of immeasurable loss.

With uncanny intelligence, instinct, and energy, Ignacy introduced the first educational television programs in his native Poland in 1957 and rose to the position of Director of Educational Broadcasting. During the mid-1960s, he served as a Paris-based program specialist in the educational use of radio and television, working for UNESCO in Chile, Cuba, Ivory Coast, Upper Volta, Mexico, Egypt, Nigeria, Senegal, Ghana, Great Britain, United States, Switzerland, and Israel. Ignacy shared the experience and insight he gained from this work by teaching and writing in Polish, German, Russian, Hebrew, Spanish, French, and English. His achievements are widely recognized in the broadcasting and academic communities on four continents.

As Director of the Office of Development Research at TVOntario, Ignacy explored his farsighted and consuming interests in adult education, media literacy, television as a primary tool for lifelong learning, and most recently, the educational uses of new technologies. His work did much to shape and guide TVOntario's progress over the last 15 years.

It is with love and respect that we dedicate this series to Ignacy Waniewicz. In its enormous scope, its thorough documentation, its emphasis on concrete results, and its concern with educational issues, this series reflects both Ignacy's vision and his intellectual legacy.

Donna Sharon
for the Office of Development Research

Preface to the Series

NEW TECHNOLOGIES IN CANADIAN EDUCATION

These papers in the series "New Technologies in Canadian Education" are the result of an international commitment. In June 1980, the Third Conference of Ministers of Education of Member States of the European Region of UNESCO adopted a recommendation requesting the member states to carry out joint comparative studies on well-defined problems of common interest in education. At a subsequent meeting of the European Region National Commissions for UNESCO, 14 subjects were agreed on for joint studies.

The theme "New Technologies in Education" was selected as study #11. The 17 countries participating in the study are Austria, Belgium, Denmark, Finland, France, Hungary, Italy, the Netherlands, Poland, Spain, Sweden, Ukrainian SSR, USSR, United Kingdom, as well as Canada, Israel, and the U.S.A. who are also members of the UNESCO European Region. At the first meeting of the national coordinators from these countries, held in October , 1982, at the University of South Carolina in Columbia, South Carolina, U.S.A., a plan was adopted for the study. In the first phase of this plan, the individual countries are to report on the ways in which the new technologies are being used in education. (A brief outline of the international design is available on request.)

The Canadian Commission for UNESCO was requested to coordinate, on an international level, the first year of the study. We are grateful to the Canadian Commission for selecting TVOntario, and the Office of Development Research (ODR) to be in charge of this task. The ODR was also asked to coordinate the Canadian contribution to the study, with financial support from the Department of the Secretary of State. We gratefully acknowledge their assistance.

In preparing the Canadian review of the use of technology in education, the ODR contacted a number of educators, academics, government officials, administrators in educational communications organizations, and others, across the country. It became apparent that there was a strong need for a well-documented account of the uses of both the "older" technologies (e.g., film, audio, television) and the newer technologies (e.g., computers, videodiscs, videotex) in the complex Canadian educational system.

Early in 1983, several types of research activities began simultaneously: designing instruments to gather information from each type of institution or interest group, identifying uses and users of each type of technology, and exploring the areas where Canada's distinctive features predispose toward technological developments. The 17 papers listed on the back of the title page emerged as a result.

Information for these papers was provided by hundreds of individuals expressing their own views or reporting on behalf of educational institutions and organizations, government departments, public and private corporations. We extend to them our sincere thanks.

I would like to acknowledge the contribution made by Thelma Rosen who assisted in the development of the inquiry instruments and played a major role in the gathering of this information. The task of supervising the final editing, production, and distribution of the papers was assigned to Donna Sharon. Her resourcefulness and persistence have contributed greatly to the completion of this series. Sharon Parker typed most of the papers from the initial drafts to their final versions. Her dedication made it possible to complete the study in such a relatively short period.

While the preparation of these papers has been supported by the Canadian Commission for UNESCO and the Department of the Secretary of State, the papers' contents do not necessarily reflect the official views of either party on issues related to technology in education.

Ignacy Waniewicz
Study Coordinator
Director
Office of Development Research
TVOntario

January 1984

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INTRODUCTION

Satellite communications technology has made real and substantial changes in the quality of life for many Canadians. Its impact has been especially important to that 20 per cent of Canada's population who occupy 80 per cent of the country's land mass which lies outside the main population corridor. The greatest density of population and the most intense development in Canada is contained in a 1,080 kilometre strip of land running from Windsor, Ontario to Quebec City, Quebec. In the western portion of the country there are concentrations of population around the provincial capitals and a few other cities. Outside of these areas the population densities are generally sparse.

Canada's topography is rugged and the climate extreme in much of the country during the winter. There are many small northern communities which are beyond the reach of roads and terrestrial communications facilities. Many other small settlements, some quite far south, are virtually isolated by mountain ranges or bodies of water. As well, the availability and quality of terrestrial transportation and communications services generally decrease the farther one is from a major population centre.

As a consequence of being geographically isolated, many Canadians are underserved with respect to education, health and social services, entertainment and a range of other amenities enjoyed by people living in the southern corridor. Improving services and the quality of life for these people is a priority of both the federal and provincial levels of government in Canada.

Satellite technology

One way to provide information and communications services to Canadians who live outside the main population centres is by using satellites to transmit information over long distances. A satellite is the space equivalent of a ground relay tower. Its basic function is to receive microwave signals from an earth transmitter and broadcast them back to an earth receiving station in another location. Telesat Canada defines a satellite communications system as a "microwave link consisting of a number of dish-shaped

antennae which transmit and receive microwave frequency signals to and from satellites stationed in equatorial orbit."[1] These links allow for all types of communications to be carried - telephone conversations, radio and television programs, teletype messages and computer data transmissions.

A satellite's beam of transmission, or footprint, can stretch across one-third of the earth. Floating at 36,000 kilometres above the equator, satellites travel at the same speed as the earth's rotation and, therefore, appear to be stationary. They are, in the engineer's phrase, "geostationary." The advantage of geostationary satellites is that they do not need to be tracked, and they afford continuous coverage of areas of the earth's surface within their view.

Microwaves operate in the Extremely High Frequency (EHF) bands of the radio spectrum. Frequencies, measured in "hertz" (in honor of Heinrich Hertz, a German physicist who created the first man-made electromagnetic radiation in 1888), indicate how many "waves" pass a given point in one second. The frequencies on the usable radio spectrum range from 10 kilohertz (KHz), or 10 thousand cycles per second, roughly the lower limit of human hearing, to 275 gigahertz (GHz), or 275 billion cycles per second, a frequency which begins to approach that of light waves and is used for radio astronomy. The outermost limit of present satellite applications is 30 GHz. High Frequencies (HF), which range from 3-30 million cycles per second, or megahertz (MHz), are used for shortwave broadcasting and aircraft and maritime communications.

The companion measure of radio waves is their length. The shorter the wave, the faster it moves and the higher its frequency. The wavelengths for the usable spectrum range from 3000 metres on the Very Low Frequency bands to one millimetre (microwaves) on the Extremely High Frequency bands used for satellite transmission.

The evolution of satellite technology in Canada

Very early in the space age, Canada saw the potential of using satellites for communications and embarked on a developmental space program. Canada's first satellite, Alouette I, was launched in September, 1962, to provide data

for the study of the ionosphere, a project vital to the improvement of HF radio communications. Alouette's expected lifespan was 12 months but for 10 years it operated in its circular orbit 1000 kilometres above the earth.

Alouette II was launched in November, 1965, and ISIS I and II were launched in January, 1969, and March, 1971, respectively. The scientific research program carried out by these satellites paved the way for the development of communications satellites in Canada.

In 1964, with 10 other nations, Canada became party to the first agreement for an international telecommunications consortium, Intelsat, to develop international communications via satellite. Teleglobe Canada, a crown corporation, became the Canadian signatory of the Intelsat agreement, and now operates these earth stations for trans-Atlantic and trans-Pacific communications using the Intelsat geostationary satellites.[2]

For domestic communications via satellite, a different kind of organization was formed by an act of parliament in 1969. Telesat Canada is jointly owned by the Canadian government and Canadian telecommunications carriers, i.e., the Trans-Canada Telephone System (TCTS) and the Canadian National/Canadian Pacific (CNCP) network. Its facilities are used for national television relay with local distribution, telephone service, computer data transfer, teletype facsimile and all forms of electronic information. It is the owner and operator of the Anik satellites, and is subject to regulation by the Canadian Radio-television and Telecommunications Commission (CRTC).

ANIK A

Canada's launch of Anik A1 on 9 November 1972 placed the world's first commercial domestic communications satellite in geostationary orbit. There were three Anik A satellites, each with a planned life of seven years. Anik A2 was placed on station in 1973 and was followed by Anik A3 in 1975. The Anik A satellites were built by Hughes Aircraft in California using major Canadian components. At launch, the satellites each weighed 560 kilograms and stood 3.4 metres high. The deployment of these satellites marked the successful implementation of the first stage of Canada's satellite communications program. The main objectives of this initial stage, outlined in a federal White Paper,[3] were to extend television service and facilitate the provision of other telecommunications services, especially telephone, to many areas of the country which previously had been without access to these services.

The footprint of Anik A covered the entire country. Its channels operated on frequencies of six and four GHz, the same bands used by the terrestrial microwave system to carry telephone traffic. This meant that care had to be taken in the placement of uplinks and receiver dishes to ensure that the microwave signals would not interfere with one another. The Anik A satellite system was successfully integrated with the existing terrestrial microwave network. This resulted in a greatly enhanced east-west telephone and television service across all seven time zones in Canada.

One of Anik A's most useful capabilities was to extend telephone and broadcast radio and television to communities in Canada's north. Prior to Anik A, the only telephone service to these communities had been provided by HF Radio. Television, where it existed, was programmed with videotapes brought in from the south.

With the advent of Anik A, the potential of satellite technology for delivering health, education, and social services over long distances became apparent. Experimental satellites opened the way for interactive telecommunications both in the professional and public sectors.

SATELLITE SYMPHONIE

From 1976 to 1979 the governments of Quebec and France cooperated in a joint venture linking the two French-speaking cultures with two-way, video communications via satellite. The objectives of this endeavor were to study the integration of satellites into a modern educational system, and to establish a methodology for using satellites in education.

Following several teleconferences between France and Quebec in 1973 using the facilities of Intelsat, the decision to work together to identify the possible uses of Satellite Symphonie was taken on 5 December 1974 by the premiers of France and Quebec. (Satellite Symphonie was built by a French/German consortium and launched by the U.S. National Aeronautic and Space Administration (NASA) in December, 1974.) Two Franco-Québécois organizations were formed in 1975 to oversee the projects: The Franco-Québécois Council on the Use of Satellites in Education (COPUSE); and the Franco-Québecois Group on the Intensive Use of Symphonie, the Experimental Satellite (GUISE).

COPUSE undertook a research experiment, the objectives of which were to document the specific methods of satellite use, the conditions of its integration into a modern system of education, and the qualitative changes such integration would provoke. To this end, two groups of 14-16 year-old students in Dijon, France and Sherbrooke, Quebec were connected by Symphonie to exchange information and insights on themes of their own choosing, such as sports and leisure, and language. The coordinators of the experiments observed that the satellite technology was virtually invisible in the context of this exchange, that is, the communications were unhampered by preoccupation with the technology. The researchers surmised that these students were already accustomed to the new communications technologies because they were an integrated part of everyday life in the modern world. Furthermore, the satellite link actually enhanced students' performances. For example, students who usually had difficulty communicating in class were quite open during the telecommunications.

The GUISE experience consisted of 80 hours of tele-work and tele-information exchanges. Tele-work encompassed tele-consultations and teleconferences between professionals in

the areas of medicine, chemistry, astrophysics, management, and, concurrent with the Olympic Games in Montreal, the physiology of physical exercise. Taking part in this exchange were researchers from the Collége de France, l'Institut d'Astrophysique, and le Centre d'Etudes Atomiques de Saclay from France, and the Université de Montréal and the Université du Québec à Trois Rivières in Quebec. The general objectives of these videocommunications were to provide opportunities for the experts to collaborate on administrative decision-making, and on obtaining experimental results in the areas of fundamental and applied research.

The tele-information facet of the project allowed 100 inhabitants of two small villages, Jonzac in France and Baie Saint Paul in Quebec, to speak to each other about their ways of life. The ultimate goals of this exercise were to encourage cultural confrontation and socio-cultural exchange.

In conducting these Symphonie projects, the coordinators had two major concerns: quantity and quality. Quantity in relation to the number of actual exchanges and quality in the precision and effectiveness of the exchanges. To this end, they encouraged sufficient planning and training in the audiovisual technology and the scientific content of the exchanges, as well as advanced preparation of slides, charts and other illustrative materials used during the telecommunications.

The evaluation of the project was conducted by a team of multidisciplinary researchers and audiovisual specialists. Using two instruments of measurement, one for the decision-making models and one to measure the time saved at each stage of the exchange, a methodology was established to allow the users to evaluate their own system. They concluded that tele-consultations represent working tools which permit either of the two teams to contribute to the discussion and the research process. In the case of tele-information, the evaluators decided that, rather than having only one broadcast/receiving centre, a capillary network of broadcast/receiving centres connected to the satellite system would allow perspectives from every corner of the country to be aired. For the researchers who had the chance to use the telecommunications capacities of Symphonie, it offered them a time-saving device as well as a device to foster international cooperation.[4]

HERMES, THE COMMUNICATIONS TECHNOLOGY SATELLITE

The next phase of Canada's satellite program was initiated with the launch, on 17 January 1976, of the Communications Technology Satellite (CTS). CTS was developed under an agreement for a joint program signed on 20 April, 1971, between the Canadian Department of Communications (DOC) and NASA. Once launched, the satellite was named Hermes. Under the agreement, Canada undertook to design, build and operate the satellite while the U.S. would provide the launch vehicle. The European Space Agency provided several components also.

The experimental Hermes satellite was designed to operate at high power (200 watts) in newly assigned frequency bands at 12 and 14 gigahertz. As the prototype for a revolutionary direct broadcast satellite (DBS) service, Hermes' high power meant that smaller, less expensive ground terminals could be used while its 12 and 14 GHz frequencies allowed it to operate without interference from existing terrestrial facilities.

In preparation for the Hermes mission, NASA and DOC invited agencies and organizations in the U.S. and Canada respectively to submit proposals for communications experiments. Use of the satellite was allocated to approved experimenters, with each country sharing the satellite on an alternate-day basis.

More than 20 Canadian organizations conducted 15 technical and 20 social experiments, including direct-to-home television and radio broadcasting, tele-education, telemedicine, community interaction, administrative services, and native communications services. The DOC provided technical assistance, equipment installation, and set-up, virtually free of charge. (For further discussion of the use of satellites in native communities and telehealth, see Papers 6 and 15, respectively.)

Individual experiments were of relatively limited duration and were also limited in their daily broadcast times, from one to four hours per day, every other day. NASA used the satellite to conduct a parallel series of educational and public service projects in the United States.

The Hermes educational experiments were conducted over a three-year period from 1976 to 1979. They marked a milestone in Canadian education. For the first time a group of educational institutions were provided with an opportunity to experiment with the capabilities of satellite communications for the delivery of educational services. Brief summaries of each of the projects follow.

Carleton University - Stanford University course exchange

Carleton University in Ottawa, Ontario, and Stanford University in Palo Alto, California, used Hermes to test the feasibility of exchanging credit courses between two universities in two countries, with a variety of orientations and emphases. The experiment used unique video frame compression and encoding techniques to reduce the cost associated with video transmission. Two modes of operation were used. In one, classes were simultaneously originated from specially-equipped classrooms at each university and transmitted to students at the other university via one-way video and two-way audio signals. Remote students could see and hear the professor and respond by using the push-to-talk microphones provided to each student in both locations. The other mode used two-way audio and two-way video to enable teleconferencing between individuals and groups separated by the 4000 kilometres between Ottawa and Palo Alto. Teleconferencing was also used by the project leaders to coordinate the overall experiment.

Four courses were exchanged during the first term, two from each university. The exchange was conducted during a two hour period from 1800 hours to 2000 hours Ottawa time, or 1500 hours to 1700 hours at Stanford.

The actual curriculum exchange began using videotapes and the mails in September, 1976 because Hermes was in eclipse and was therefore shut down due to lack of power. (Geostationary satellites are eclipsed twice each year for a period of about six weeks centred on the Spring and Fall equinoxes. Now when satellites are shadowed by the earth they rely on rechargeable batteries for their power.) This resulted in confusion and a marked dampening of student enthusiasm for the project. From mid-October 1976, when the satellite again became operational, until the completion of the curriculum exchange at the end of April, 1977, the

experiment proceeded smoothly, but with many fewer students than expected in the "distance education" mode.

According to Hofman and George,[5] "the curriculum exchange project itself was an experiment in satellite technology, but in addition it was based on experimental methods of television signal processing." The students who participated in the curriculum exchange found "that the television and satellite system was virtually transparent to them, except when it impeded that which they would have liked to do."[6] An example of an activity which the students would have liked was the opportunity for informal discussions with the distant professor. However, when the opportunity to hold "electronic office hours" via satellite was presented, the students were apparently too shy to participate. The experimenters noted that that was not surprising. Interaction between students and lecturers was judged to be about the same as in a regular classroom setting. Students rated the satellite instructional system as "untrustworthy" probably because of technical difficulties experienced during the project. Interestingly, they also rated the experience as more "warm" and "sensitive" than that of a large group of students in a regular classroom situation.[7]

Réseau Omnibus, Université du Québec

The Université du Québec is a multi-campus organization with several branches in widely separated locations within the province of Quebec. From 19 October 1976 to 23 March 1977, the Université du Québec conducted a series of 12 different educational experiments among the various campuses of the university. The overall objective of the project was "to simulate the real operating conditions of a network of the Omnibus type in a university community scattered over a vast territory."[8]

Experiments conducted at various campuses of the Université du Québec included:

i) Teleteaching: Students in Hull participated in a graduate seminar in public administration delivered from the Quebec City campus.

ii) Teledocumentation/Telereference: Students located at Rimouski consulted librarians at Trois Rivières and

students in the Gaspé Peninsula consulted librarians located in Rimouski via one-way video, two-way audio satellite transmissions. The transmission of pertinent documents was carried out later by facsimile over telephone lines.

iii) Professional Development: Teachers on the Ile d'Orléans participated in a professional development course delivered via satellite from Trois Rivières, a distance of about 140 kilometres.

iv) Telework: Documents were exchanged between the offices of the Registrar at the Hull and Rouyn campuses via a two-way satellite video link.

v) Telemicroscopy: Scientists at Trois Rivières, Rimouski and Quebec discussed electron microscopic images transmitted via satellite from the Armand Frappier Institute in Laval.

vi) Teleconferencing: The campuses at Hull and Rouyn conducted a series of short courses and lectures in a teleconferencing mode using the satellite to provide video links to Val d'Or and Chibougamau and audio links with other centres.

vii) Community Interaction: In a community exchange program organized by the University, groups of citizens at Saint-Raymond-de-Portneuf (30 miles from Quebec) and Buckingham (60 miles from Ottawa) exchanged pictures of their communities, recipes, stories, and memories.

viii) Scientific Research: A research station installed in a lighthouse at Métis Beach received oceanographic data and re-transmitted them via satellite to the INRS-Océanologie laboratory at Rimouski.

Evaluations of the Omnibus Projects produced two general conclusions: that an Omnibus Network is both feasible and desirable in terms of the functions and communication requirements of the University, and that a specific advantage of the satellite is to make possible cost-beneficial communications over very long distances as well as communications with locations that lack terrestrial telecommunications facilities.

However, the evaluators concluded that an Omnibus Network based exclusively on satellite delivery is not warranted in terms of the needs and functions to be served. Rather, a terrestrial system with some satellite delivery capability integrated with it would appear to be the best alternative for the continued development of the University's Omnibus Network.

Continuing Medical Education,
Memorial University of Newfoundland

Beginning on 28 March 1977 and continuing until 18 June 1977, the Faculty of Medicine at Memorial University conducted a series of experiments in continuing medical education. Courses originated at the University in St. John's and were transmitted via satellite to four remote hospital sites: St. Anthony and Stephenville on the island and Labrador City and Goose Bay in Labrador.

Full-color TV signals were transmitted to the remote sites which were able to communicate with the University via return audio links. Most sessions were conducted in a mixed lecture and seminar mode and made frequent use of film and other audiovisual materials. A noteworthy finding of this series of experiments was the amount of audio interaction among the remote sites and the benefits which participants gained from this capability of the satellite system.

Course segments broadcast included continuing medical education, continuing nursing education, standards in health care, community health education, and a number of special programs. As well, a number of teleconsultations were conducted using slow-scan television, i.e., the transmission of still-frame pictures via telephone lines, to send images from Labrador City to the University. The transmission of medical data such as electrocardiographs (EKG), electroencephelographs (EEG), and electromyograms (EMG) was also accomplished.

"The interactive capacity of the satellite system was viewed as a major reason for our participation. Our experience in actually using the system, however, showed that interaction did not just happen, but had to be encouraged in a number of ways."[9] Having a moderator for each of the interactive sessions was found to be a good way of promoting

interaction, as was holding discussions of topics which were intrinsically interesting to the participants. Simulation of satellite sessions in a closed-circuit terrestrial system was found useful in training the tutors to elicit interaction from participants in actual satellite sessions.

The conclusions reached by the experimenters were as follows:

1. Telecommunications links have a potential role in the delivery of various aspects of health care and the education of health professionals in remote areas.

2. The activities were carried out via satellite because the system was offered at no cost. The same project could have been conducted had similar facilities been freely available on terrestrial communications systems.

3. Funding policies should be developed by various agencies as experimenters need funding to support further work.

4. The interests of experimenters, funding agencies, systems developers, etc., may not be identical, even though all are focussed on the same technology. It seems important to identify and define these interests at the outset of a project.

5. Future telemedicine projects should devote more attention to the personal implications of utilizing telecommunications, as these factors will influence the extent to which telecommunications are adopted in both health care and other public service applications.

6. Future experiments with both satellite and terrestrial systems are fully justified and are needed to resolve questions about the most cost-effective method of delivering educational and medical services over various distances. Projects using a comparative research design seem necessary to clarify the relative merits of the different technologies.

7. Further research in telemedicine should involve health care professionals, and should relate telemedicine to current research in health care delivery. Otherwise, such projects may continue to be open to the criticism that

telehealth is "an expensive toy" and peripheral to the crucial issues in contemporary medicine.[10]

Staff training, Public Service Commission

The Public Service Commission of Canada, which has a wide-ranging mandate to provide staff training for members of the federal public service, conducted a Hermes experiment in staff training during the period 12 April 1977 to 16 June 1977. The major objective of the experiment was to test the viability of using satellite telecommunications to conduct interactive training and development activities.

Students in four separate, specially equipped classrooms at Memorial University were linked via satellite to the Bureau of Staff Development in Ottawa. The layout of each classroom was designed to maximize learner participation by creating a comfortable, convenient environment to serve a maximum of five students. All sites had two-way video and two-way audio communications.

The course, "Long Range Planning in Government," was presented using a student-centred, instructional model. The model was developed to take advantage of the two-way capability of the satellite system and to promote a maximum amount of interaction among the course participants at the various sites. A control group was given the same course in the classroom mode.

The evaluators of the project used an experimental design to test a number of research hypotheses related to both the learning model and the satellite teaching set-up. Their results indicated that the satellite video system was as effective and as well-received as a regular classroom experience when used for task-oriented training.

Satellite Tele-education Program, British Columbia Ministry of Education

The British Columbia Ministry of Education's Distance Education Planning Group (DEPG) used the Hermes satellite to conduct a series of demonstration projects between October and December, 1977. The DEPG invited the British Columbia Institute of Technology (BCIT), four of the regional colleges

(Okanagan, Northern Lights, North Island and Fraser Valley), and the three public universities (University of British Columbia, Simon Fraser University and the University of Victoria) to form a production and delivery consortium for the duration of the Hermes experiment in British Columbia. Named Satellite Tele-education Program (STEP), the objectives of this experiment were to test the feasibility of using satellite delivery for distance education, to test a consortium model for program development, production and delivery, and to experiment with a wide variety of programming formats and types.

Programs assembled by the participating institutions were transmitted from Vancouver via satellite to community colleges in Dawson Creek, Kelowna, Chilliwack, Campbell River, and Pitt Lake. In three of these sites, the local cable TV operators distributed the programming to the community at large, while special viewing studios were created in the other two centres. A TV receive-only (TVRO) terminal was located at Pitt Lake, where loggers at a remote camp site could receive program transmissions.

A variety of presentation formats were used for the 64 hours of programming broadcast. These ranged from expert panels to highly interactive teleconferencing sessions. Considerable use was also made of film and other audiovisual materials. Audience participation was via telephone to the local site and then via Hermes to the studio.

This project was unique among the Hermes experiments in the total number of different institutions which were involved. Organized and managed by the Ministry's Distance Education Planning Group, operated by the Provincial Educational Media Centre, and programmed by a number of the province's postsecondary institutions and some government departments, the Satellite Tele-education Program was a real test of a consortium model for program delivery.

Evaluations of this project indicated that it was well organized and executed. As with other Hermes educational experiments, both programmers and participants viewed the interactive capabilities of the satellite as a major, valued feature. Other findings and recommendations were related to production, program content, communications and audience factors of the experiment.

There was general agreement among participants that the project had realized all of its objectives. "As a direct result of STEP's success, a proposal is being prepared for a pilot project on Anik B."[11]

Camp TVOntario

In July, 1978, the Ontario Educational Communications Authority (OECA, or TVOntario as it is more commonly known) set out to provide a learning system focussed on fostering the creativity and participation of children and adults who work with children. Camp TVOntario, developed in conjunction with the Hermes Satellite experiment, was a short-term project that combined the TVOntario Academy format with a satellite delivery system to reach individual home viewers as well as public library and recreation groups with a stimulating television resource package. A TVOntario Academy encompassed the following four components: the broadcast of already-existing programs in some kind of contextualization; a print package; pre-broadcast utilization fieldwork; and the capacity for distant learners to respond in some way to the information source.

Camp TVOntario was broadcast three times a week for one hour, 20 minutes to TVOntario's network region as well as transmitted via satellite to the outlying communities of Chapleau, Fort Frances and Owen Sound in northern Ontario. The return audio link was the terrestrial telephone network. A strong effort was made to integrate Camp TVOntario with ongoing community activities and to encourage interactive participation. It was important for the success of the project to show viewers how television can be used as a springboard for other activities.

In Fort Frances, the public library centred all children's activities in July around the Camp. Thirty children watched every Monday, Wednesday and Friday, and got involved in related activities under the direction of the children's librarian.

In Owen Sound, the Summer playground staff of the Recreation and Parks Department brought groups of 75 children to the public library for selected programs. A Children's Services Committee has been formed as a result of the project.

Unfortunately, difficulties encountered in the sound transmission of the broadcasts prohibited their use in Chapleau. However, the Camp TVOntario tapes were used in schools there in the Fall of 1978.

The project clarified a way to work with home viewers and public libraries more effectively, and brought new awareness of the potential of Academies as a way of providing a directed and informal learning experience in the open sector.[12]

Direct broadcast satellite experiment, Department of Communications, Canadian Broadcasting Corporation, and the Ontario Educational Communications Authority

From 1 January to 30 June 1979, the Canadian time on Hermes was dedicated to trials of direct broadcasting to communities using Canadian Broadcasting Corporation (CBC) and OECA programs. The objective of these experiments was to evaluate how acceptable viewers found the quality of television reception, as well as how reliably the small earth terminals performed when used by unskilled persons in a wide range of climatic conditions.

Four television receive-only (TVRO) terminals with antenna sizes of either 1.2 or 1.6 metres were located at schools in the small communities of Summer Beaver, Slate Falls, Mine Centre, and South Bay Mine in northwestern Ontario to receive OECA educational programs during normal school hours. Three 1.6 metre TVRO terminals were placed in community centres in Makkovik, Postville, and Hopedale, Labrador, to receive the CBC Northern Service during the evening hours. This six-month experiment demonstrated reliable operation of these TVRO terminals even during the worst Canadian winter conditions, when the outdoor equipment was exposed to rain, snow, ice storms and blizzards, with temperatures as low as -45C. All the communities reported excellent reception of television throughout the experiment and expressed confidence that similar performance could be achieved in an operational situation.[13]

Results of the Hermes educational experiments

The single most important finding of the Hermes experiments was the importance which experimenters, professors/teachers and students/participants attached to the interactive, two-way capabilities of the satellite system. The Hermes experiments were unique in providing the first major test in Canada of a distance education system with the capability of real-time, audiovisual communications between geographically distant locations. The Public Service Commission experiments utilized two-way audio and two-way video communications. Other projects used one-way video transmission to the remote sites and relied on satellite or terrestrial telephone circuits to provide the return, two-way interactive audio capabilities. Regardless of the configuration used, participants were consistent in rating the ability to "talk back" as a very important or essential feature of satellite tele-education.

The Hermes projects also demonstrated that a variety of traditional educational techniques such as lectures, seminars, and panel discussions could be readily adapted for the delivery of distance education via satellite.

Problem areas which were identified by the Hermes experiments included funding for tele-education, difficulties in organizing and coordinating projects, and problems in handling the non-satellite portions of distance education courses.

Hermes experiments lasted from October 1976 until the end of June 1979. They demonstrated that communications satellites could indeed be used for educational and public service purposes. As Casey-Stahmer[14] stated: "The Hermes experiments were essentially catalytic in nature... they created awareness of new applications of communications technology." In the process, they created a demand for additional, longer term "pilot projects" to test the feasibility of delivering a range of educational and social services on an operational basis.

THE ANIK B PILOT PROJECTS

Hermes created a new awareness and heightened sense of expectation for the potential of satellite technology, an awareness which was reflected in a Department of Communications press release heralding the launch of Anik B on 15 December 1978:

> With the new Anik will ride the hopes of many Canadian medical personnel, educators, broadcasters, native peoples' organizations and others working with the federal Department of Communications (DOC). They'll be participating in a $36 million program to use a unique feature of the new Telesat Canada space craft to bring a variety of promising new social uses of satellite communications out of their current experimental stage and closer to everyday reality.[15]

The early success of the experimental 14/12 GHz technology pioneered with Hermes led to its incorporation into Anik B. The result was a dual-band, or hybrid, satellite with both 6/4 GHz and 14/12 GHz transponders. Telesat used the 12 channels in the 6/4 GHz band for commercial users such as cable operators and broadcasters. The Department of Communications leased the six channels on the 14/12 GHz from Telesat for a series of 16 educational and public service pilot projects.

For the Anik B program, the Department of Communications continued to provide assistance to the project groups. This included free satellite time, free transmission and receiving equipment, technical assistance and a range of other services. Anik B projects involved the distribution of tele-education, telehealth, broadcast programs, community communications, business and government communications and a variety of technical experiments.

Anik B was configured with four footprints, labelled West, Centre West, Centre East, and East. This arrangement meant that different programs could be broadcast in the different regions of the country.

The increasing importance allocated to the role of satellites in Canada was reflected in the objectives established for the Anik B Communications Program. These were:

- To foster the development and introduction of new satellite telecommunications services and systems by continuing to support demonstrations, experiments, pilot projects, and trials which are designed to further develop awareness, knowledge and expertise; to assess the viability of these new services and systems in the 14/12 GHz frequency band, and to consolidate the results of these activities.

- To test direct satellite-to-home broadcasting using small portable ground stations known as low cost earth terminals (LCET) stationed on the premises of individual homes.

- To facilitate the introduction of new services on commercial satellite systems in Canada by exploring means to aggregate user needs and by providing a vehicle for limited interim service.

- To support the advancement of Canadian capability in satellite communications technology and service delivery by assisting Canadian user institutions, industry and the carriers to respond to national needs and international market opportunities.

- To stimulate telecommunications policy development by identifying issues and providing relevant data.[15]

The Department of Communications leased Anik B's 14/12 GHz capacity for an initial two-year period. Phase I pilot projects began on 1 April 1979, and lasted until the end of February, 1981. Phase II projects began in March, 1981, and continued for a nineteen month period until the end of September, 1982. A final Phase III began in October, 1982, and is still ongoing.

In the descriptions which follow, each of the Anik B educational pilot projects is treated as a continuous project without regard to the official phases. Seven Anik B projects were primarily educational or involved educational

programming as part of a larger group of services. Each of these will be described briefly.

TVOntario Spring Academies, April-June, 1979

An early Anik B pilot project of three months' duration was the TVOntario Spring Academies, used to test the feasibility of the Academy concept in four northern sites. The objectives of the Spring Academies pilot project were:

- To provide an opportunity for people living in remote communities to become involved in informal but directed learning experiences.
- To create a general understanding of television, its interactive dimension and its potential as a resource for learning.
- To provide learning opportunities in remote communities in cooperation with appropriate required agencies via satellite.

Television programs were delivered via Anik B to the communities of Geraldton, Manitouwadge, Marathon and Owen Sound. The interactive component of the Academy was provided by a two-way audio-teleconferencing system linking the four communities.

The Spring Academies project marked a turning point in TVOntario's involvement with satellite education. This pilot project was very successful and led to the subsequent involvement of TVOntario in the Program Delivery Pilot Project, East. During the Phase II program, a much more extensive project covering 44 sites in northern Ontario was conducted.

Program Delivery Pilot Project, East

In September, 1979, TVOntario co-sponsored a project with the Ontario Ministries of Transportation and Communications, Northern Affairs, and Culture and Recreation as part of the "Northern Ontario Hybrid Direct Broadcast Operational Trial." Anik B was used to deliver 94 hours of regular programming

per week to homes, community cable companies, schools, libraries, a prison, and other locations throughout Northern Ontario equipped with LCETs and TVROs.[17]

"TVOntario has as its objectives:

To raise the awareness of the potential value of delivering TVOntario programs and educational services via satellite to Northern Ontario; to gain operational experience; to examine the demand for alternative TV services in the remote areas of Northern Ontario; to examine the need for contextualization of educational programs when delivered to isolated and remote areas; and, to examine the subjective acceptability of varying the technical signal quality in remote areas."[18]

Three separate evaluation studies were conducted during this project. The following are among the important findings of these studies:

Social impact

- Northern residents do not believe that expanded television services will have any universal impact on their basic way of life.

- Northern residents, however, do perceive extended television services as contributing to their overall quality of life and diminishing their isolation from people in the south.

- Northern residents consider television's capacity to inform as important as its ability to entertain.

- Both northern and southern residents perceive that any social effects of expanded television services will have their greatest impact on children.

Program demand

- Program appeal is strikingly similar between northern and southern residents, however, the northern audiences expressed a greater demand for children's programming, local news, movies, and comedies. Southern audiences expressed a greater need for cultural programming.

- The northern French differ from both the English groups in their greater demand for information programs.[19]

This project was primarily a test of the viability of extending television service to remote areas using a combination of direct broadcast satellite transmissions to individual sites and community-based distribution. A significant outcome addressing this objective, as reported in the project evaluation, is that

> ...the TVOntario distribution system had reached the financial cross-over point, i.e., the point at which further increases in coverage would be significantly cheaper if the basic mode of signal delivery was via satellite as opposed to a terrestrial distribution system. The provincial Cabinet had taken note of this fact, and had authorized the OECA to transfer to a satellite mode of signal delivery at the appropriate time.[20]

Northern Ontario Distance Education project

TVOntario is currently conducting the Northern Ontario Distance Education (NODE) project with the cooperation of the Lake Superior Board of Education, the Ontario Ministry of Education, and the Department of Communications. The major objective of this developmental project is to evaluate the feasibility of using satellite telecommunications to deliver distance education in the form of two-way data communication via Telidon to students disadvantaged by geography. Seven high schools in northern Ontario are being provided with a full two-way interactive Telidon service via satellite links to Anik B's 14/12 GHz band operated from the Communications Research Centre near Ottawa. Fort Frances, Kapuskasing, Kirkland Lake, and Owen Sound high schools are equipped to receive voice or data transmissions, while high schools in Terrace Bay, Marathon, and Manitouwadge receive data only.

A Telidon database consisting of Grade 13 physics content, Bell's VISTA information services, and TVOntario educational content has been designed to enhance the range of educational opportunities and educational content available in these relatively isolated schools.[21] This project also gives students from these schools full access to TVOntario's Edutel database which includes the Student Guidance

Information System, a 6,000-page database of student career guidance information. Future plans call for adding a full data satellite service to carry both videotex and computer communications.[22]

> "It is hoped that the successful demonstration of this remote data retrieval application using two-way satellite technology will pave the way to a more general application to distance learning for Ontario."[23]

Program Delivery Pilot Project, West

This program was unique in that its technical objective was to test the transmission of two TV signals (two video and two audio) over one transponder on the Anik B satellite. Thirty-four LCETs and three TVROs were used to deliver two channels of commercial television (CBC and BCTV, the CTV network affiliate in British Columbia) to isolated sites in British Columbia, the Yukon, and the Northwest Territories.

The major objectives of this project were:

- To demonstrate, evaluate, and gain field experience with a direct-to-home and small community program delivery service, using the Anik B satellite 14/12 GHz transponders.
- To provide a prototype testing ground and a small initial market to help stimulate the industrial sector to develop a line of internationally competitive products for this service.
- To provide information to the government which will contribute to policy development and plans respecting the future operational use of broadcasting satellites.
- To provide information to the various agencies, institutions, and corporations interested in satellite broadcasting to help them formulate plans for future activities in this field.[24]

As a broadcasting experiment, this project was judged successful in demonstrating that satellite signals could be distributed directly via both cable head-ends and low power community re-broadcasting transmitters.

The initial success of this project, combined with the results of the Hermes experiment, contributed to the formation of The Knowledge Network of the West Communications Authority in 1980.

The Knowledge Network began delivering educational television services via Anik B during January, 1981, to homes and institutions throughout British Columbia. Knowledge Network shared the western transponder of Anik B with the Program Delivery Pilot Project, West, and initially used the same distribution network. As well, a provincial government-sponsored program was developed to allow small communities to establish community satellite receiving and re-broadcast stations. This program has provided for a marked expansion of the Knowledge Network's service area.

ACCESS Alberta pilot project in tele-education

During the Phase I Anik B projects, ACCESS Alberta conducted a brief and logistically difficult project in cooperation with the British Columbia program. This consisted primarily of sending tapes to the British Columbia Institute of Technology for transmission via Anik B into the Centre West beam which covered Alberta. Only a limited number of sites in Alberta could receive programming.

Objectives of this project were to: gain first-hand operational experience for ACCESS Alberta and its cooperating institutions, begin training of technical and programming staff in the use of 14/12 GHz technology, and, assess distance education needs with particular emphasis on rural Alberta.[25]

While this project was hastily organized and conducted on a very limited scale, it did pave the way for a more extensive pilot project during the Phase II Anik B program.

The Phase II tele-education project, which began in the Spring of 1982, provided approximately six hours of programming per week to colleges and cable systems in High Level, Peace River, Grouard, Grand Prairie, Fairview, Calgary, and Edmonton. The programs originated at the ACCESS studios in Edmonton. This project was conducted in cooperation with a number of postsecondary institutions. Both prerecorded and interactive, electronic classroom type

presentations were delivered. The electronic classroom sessions used a studio-equipped classroom and the terrestrial telephone system to provide the one-way video, two-way audio link.

As a result of these experiences, ACCESS has proposed that it develop its own capability for educational program delivery via satellite.

Quebec Department of Education: La Grande Causerie

The Quebec Department of Education and the New Quebec School Board conducted a 15-month project in which educational services were delivered using two-way video, telephone and teleconferencing between Montreal and Radisson near James Bay in northern Quebec. Programming was directed toward teachers, students, and administrators in Jacques Rousseau School as well as adult education students from Radisson and Chantier.

The project consisted of two phases: 1) a two-way video phase lasting five months between April and August, 1979, and 2) an audio phase lasting 10 months (a full academic term) from September, 1979 to June, 1980.

The two-way video was used extensively for interactive exchanges between different groups in the studio at Jacques Rousseau school and a studio of the Department of Education at Montreal.

Elementary school students exchanged information about their respective communities and lifestyles, presented the results of class projects and conducted informal meetings. Secondary school students at Radisson received an eight-part information series on les Collèges d'Enseignement Général et Professionel (CEGEP) and a short course on poetry. Adult education students at Radisson received courses on parent-child relations and economics. As well, there were meetings and information sessions for teachers, administrators and professionals. In all, 154 hours of interactive television were conducted.

Results of the project were generally favorable. Students, teachers, administrators and others adapted readily

to using the system and the majority agreed that they would participate in such experiences again, given the chance.

Quebec Department of Education: Kativik School Board

The Quebec Department of Education and the Kativik school board conducted an Anik B project to "test whether satellite communications could improve the availability of quality education in the northern Quebec school district of Kativik."[26]

Five Inuit communities in the Quebec Arctic were connected via a satellite system with two-way audio and broadcast video capabilities. This project was closely linked to the Naalavik II Community development project of the Taqramiut Nipingat Inc., a corporation formed in 1975 to develop communications services for the Inuit of Arctic Quebec. The Kativik School Board project was significant because it marked the first time that any of these communities had ever received television. The Inuit of these communities established as a precondition to receiving the television service that it must respect their way of life and culture. In practical terms, this meant "that there should be programs in Inuktitut and that the people should have control over the introduction of the medium."[27]

Up to 12 hours per week of educational programming were distributed in English, French, and Inuktitut between October 1980 and February 1981. This program merged with the Naalakvik II project in its later stages, and the number of hours of educational programming transmitted from Ottawa to all five sites was reduced to two per week. Up to nine hours of original Inuktitut programming were also carried on the satellite network.

Memorial University of Newfoundland telehealth project

The Faculty of Medicine at Memorial University used Anik B to provide audio, data, and slow-scan video connections between medical facilities in St. John's, Goose Bay and Labrador City. This network was used for telehealth, community health education, and continuing medical education.

A major objective of the project was to test the feasibility of linking the three health stations connected via satellite with the existing terrestrial health teleconferencing system which connects more than 30 health centres throughout Newfoundland. Results of the project established both the viability and user-acceptability of the hybrid teleconferencing system. A certain level of technical expertise had developed in Newfoundland as a result of Memorial's involvement in the Hermes and Anik B satellite projects. The satellite projects have had significant influence on the provincial government's policy in the field of communications, particularly their consideration of the use of DBS.

One result is that the Newfoundland Telephone Company is now actively pursuing the potential of satellite delivery for increasing service to off-shore and isolated communities. The stage is now set for a group in Newfoundland to prepare for an extensive pilot project to test MSAT (or Mobile Satellite, a service designed to improve the mobile radio services used by firefighters, truckers, police, military vehicles and others) using Newfoundland as a "living laboratory" to evaluate this technology.[28]

Results of the Anik B pilot projects

The Anik B pilot projects in tele-education are only one part of a much broader program sponsored by the Department of Communications. A major goal of this program is to achieve "the orderly growth and establishment of a viable Canadian commercial telecommunications system, services and industry."[29]

Viewed in this context, the program delivery pilot projects which made extensive use of the direct broadcasting capability of Anik B were very successful. On the whole, the experience with Anik B has sparked increased and continuing interest on the part of provincial educational organizations in using satellite telecommunications systems to deliver their programming, increasing their penetration for existing services and opening up new educational markets (e.g., outside of institutions). This interest seems to be backed up by funding as various provincial ministries begin to recognize that 14/12 GHz satellite communications systems offer the potential to equalize service delivery throughout a

province. This recognition stems in part from the generally positive response of participating communities who are enthusiastic about the potential for expanded telecommunications services.[30] As a result of the Canadian experience, direct broadcast services are underway or proposed in the United States, Japan, Europe and Australia. There is also considerable policy debate concerning the future role for direct broadcasting services in Canada. The Anik B projects have contributed to the identification and at least partial resolution of some important policy issues. These include a new policy liberalizing the ownership of ground terminals and a more flexible policy regarding the leasing of satellite transponders by educational broadcasters.

ANIK C OPERATIONAL PROJECTS

Three Anik C satellites have been constructed with direct broadcast capability using a receiving antenna of about 1.2 metres in diameter. The third one built and the first to be placed in orbit, Anik C3 was launched by the U.S. space shuttle Columbia on 11 November 1982. It operates on the 14/12 GHz band and has a life expectancy of 10 years. Both the Knowledge Network of British Columbia and TVOntario transferred their educational broadcast services to Anik C3 during January 1983.

TVOntario

TVOntario is a major educational media organization with extensive production and broadcast distribution capabilities. During 1982-83, it commanded a weekly audience of 2,200,000 with the average viewer spending 2.6 hours per week watching TVOntario.[31] Financing is provided by the Ontario Ministries of Recreation and Culture, and Education, with some revenues derived from the national and international sale of programming. Some revenues recently have been obtained from voluntary public subscriptions and corporate underwriting.

In 1982-83, 1,184 hours of English-language and 156 hours of French-language programming were produced or acquired. Over one-quarter (308 hours) of the programming was produced in-house on a production budget of $15,000,000. TVOntario reaches an estimated 92 per cent of Ontario's population of 8.7 million with a broadcasting system consisting of three medium and nine high-power transmitters, and 75 low-power transmitters. More than 150 cable systems carry TVOntario's signal to viewers across the province.[32] Service from the originating station in Toronto is provided to re-broadcasting stations throughout Ontario by both terrestrial and satellite links. Significant expansion is in progress to extend this service.

TVOntario was an initial experimenter in the Hermes satellite program and continued an ongoing series of projects on Anik B. Chief among these was the extended field trial of direct broadcast satellite delivery to 44 isolated locations in northern Ontario. This project was instrumental in shaping TVOntario's plans for operational satellite services.

A major outcome of this trial was a program sponsored by the Ontario Ministry of Northern Affairs to provide low power re-broadcast transmitters (LPRTs) to isolated communities throughout northern Ontario. TVOntario now uses Anik C3 for the distribution of its regular educational television programming. Anik C distributes TVOntario's broadcast signal to 12 main regional transmitters and 75 LPRTs throughout Ontario as well as to 25 cable television companies. (See Appendix.)

Knowledge Network

Knowledge Network, British Columbia's educational communications authority, was established on 28 May 1980 with a three-pronged mandate to establish and operate a telecommunications network for B.C.'s educational institutions, cooperate and collaborate with the educational institutions in the delivery of distance education services, and, foster, stimulate, and participate in the development of high-quality learning systems.

A major challenge for the B.C. educational system is to provide access to quality learning opportunities for 40 per cent of the population scattered about the major land mass of the province. These people live in small communities and settlements which are often separated and isolated both from one another and from the main population centres on the Lower Mainland by great distances and barriers of mountains or sea.

Encouraged by the federal Department of Communication's call for participants in the Hermes and Anik B Satellite experiments, the B.C. Ministry of Education's Distance Education Planning Group inaugurated two projects - the Satellite Tele-education Program (STEP) and the Program Delivery Pilot Project, West - to test the feasibility of using satellite technology to deliver distance education courses throughout the province.

The success of these projects led to the establishment of the Open Learning Institute in 1978. With a mandate for university, college, technical, and adult basic education, the Open Learning Institute began operations using correspondence course materials and telephone tutors as the basic delivery mode. Then in 1980, the Knowledge Network was established to provide a satellite delivery network for

programming produced by the province's educational institutions. The resulting arrangement can be described as a distance education learning system.

The Knowledge Network delivers educational programming throughout British Columbia via Anik C3 with a distribution network which includes community cable television, low power community re-broadcast transmitters and direct broadcast earth receiving terminals. Approximately 100 hours a week of educational programming are currently provided to 150 communities.

Two major types of programming are delivered via the network: telecourses and teleseries. Telecourses are credit courses which include a package of resources and study materials combined with television programs of live electronic classroom presentations. Electronic classroom is the term applied to the Knowledge Network's two-way, interactive presentation mode. Using this approach, students view a lecture/seminar presentation and ask questions and make comments by phoning the instructor.

Teleseries are series of noncredit, television programs addressing particular topics or issues. These may also include an electronic classroom component.

All of the telecourses which involve credit are presented in cooperation with an existing educational institution. The cooperating institution produces the telecourses, enrolls the students, collects the tuition, and grants the credit. Program development services in the form of staff training and technical assistance are made available to the cooperating institutions by Knowledge Network, but the cooperating institution retains full responsibility for developing and delivering the course. In some areas, local learning centres have been established in cooperation with a university, community college, or local school district.

During 1982-83, there were over 8,000 students enrolled for courses offered through the Knowledge Network in cooperation with the postsecondary sector of British Columbia. This includes: three universities (two located in Vancouver and one in Victoria), 15 colleges, and, four technical institutes. With these institutions providing the courses, the Knowledge Network delivers distance education

via satellite which can currently be received by about 85 per cent of the province.

The major objective being addressed by these initiatives was to develop new ways to provide better access to educational opportunities for the people of British Columbia. Forsythe and Collins[33] emphasize this point:

> ...it was the philosophical ideal of equal educational opportunity for all which was the driving force behind the creation of the system as it exists today, and not technological determinism. The technological innovations were a means to an end, serving to 'open the door' to learning for a dispersed and educationally-disadvantaged population, helping educators to overcome the barriers of distance and terrain.

The Atlantic Satellite Network

As part of the conditions of its May, 1983 CRTC license to broadcast on the Anik C3 satellite, Atlantic Television must allot 20 per cent of its satellite broadcast schedule to educational uses. This works out to about 20 hours per week, from 1000 to 1200 hours and 1300 to 1500 hours on weekdays; occasionally time is available on weekend afternoons. During the first two academic terms of Atlantic Satellite Network service, four universities sponsored telecourses over the system.

The Distance University Education via Television program (DUET) at Mount Saint Vincent University in Halifax, Nova Scotia, uses a studio-equipped classroom to transmit live, interactive credit courses to distance learners throughout the four Atlantic provinces (Nova Scotia, Newfoundland, New Brunswick and Prince Edward Island). The signal is beamed up to Anik C3, transmitted to 16 receiving centres across the four provinces, and then distributed by local cable companies to individual homes and businesses. DUET's objective is to transfer the basic university experience to a distance education environment.

During the Fall and Winter 1984 terms, two gerontology courses were offered, each running three hours per week. Many of the registered students were practicing professionals

in the health care field whose employers arranged for them to follow the courses during working hours.

A traditional classroom/lecture format was used, and distance learners could participate in the class over the phone, either by calling collect or via a dedicated line set up for local students. Occasionally, DUET leased time on Maritime Telephone and Telegraph's (MTT) "meet-me bridge," a teleconferencing device which allows 10 callers to participate at once (see Paper 14). MTT's rental fee for the meet-me bridge is $330 per month plus long-distance telephone charges. DUET students have expressed enthusiasm for teleconferencing and are willing to pay higher tuition fees to subsidize the rental costs. Currently, tuition is $129 plus $25 for additional materials such as textbooks and photocopies. Enrollment in DUET's courses reached 160 over the two terms and the response from students was generally positive. Off-campus students performed as well or better than those on campus.[34]

The Atlantic School of Theology used Mount Saint Vincent's classroom/studio to produce a sequence of professional development seminars for practicing clergy. A receiving centre was set up at the University of Prince Edward Island.

Acadia University in Nova Scotia, and the University of New Brunswick (UNB) collaborated on a viewing schedule for the TVOntario microcomputer literacy series, "Bits and Bytes," and the French version, "Octo-Puce." The program was used by Acadia as a component of a degree-credit course for teachers, and by UNB as one element of a noncredit course in microcomputer basics.

The Nova Scotia Department of Education's Media Services Branch uses the Atlantic Satellite Network to transmit purchased programs to public schools throughout the province. Rather than spending time duplicating tapes for each school, Media Services schedules regular transmissions and publishes these schedules in the weekly TV listings so that school teachers and administrators, as well as the general public are made aware of them. Generally, schools tape the programs to keep in their tape libraries for future use.

The provincial and federal governments collaborated to sponsor a 10-part NFB film series for the Atlantic provinces tourist industry titled "Tourism is Your Business." The films instructed on how to encourage tourism and how to maximize tourism's profit-earning potential. A textbook was used as part of the learning package.

Several projects have been proposed for the upcoming school term. Holland College in Prince Edward Island has proposed for Fall, 1984, a series of 15 to 20 half-hour programs on bookkeeping for the small business. Saint Francis Xavier University in Nova Scotia will be making available videotapes of some of its Alumni Institute lecture series and has also prepared a set of four videotapes dealing with issues of unemployment. Other proposals include a series on the Atlantic fisheries, one on research in Atlantic Canadian universities, and degree-credit courses for the penitentiary system.

One drawback of the Atlantic Satellite Network is that its signal can be picked up only in those areas which are wired for cable. Those who live in areas not served by cable presently have no access to the programming carried by the network.

Uplink 84

In November, 1983, the federal Department of Communications gave the University of Saskatchewan 40 hours of free uplink time on the Anik C3 satellite to transmit live, interactive educational programming to the four western provinces (British Columbia, Alberta, Saskatchewan and Manitoba). The signal from the University of Saskatchewan was carried in British Columbia on the Knowledge Network; in Alberta, 11 cable companies carried the signal; in Saskatchewan, nine cable companies participated, and in Manitoba, five cable companies distributed University of Saskatchewan programming. Most of the programs originating from the University of Saskatchewan were each one hour long and were broadcast on Sundays.

The basis of the whole project was VETNET, a continuing education series originating from the Western College of Veterinary Medicine in Saskatoon and delivered via cable to practicing veterinarians in their homes. The series, which

ran from 22 January to 30 March, 1984, was broadcast live with viewer response possible via collect telephone calls. The program content included taped segments of farm clinics demonstrating innovative veterinary techniques, as well as live in-studio discussion and viewer feedback.

In another project, the professors in the Faculty of Education at the University of Saskatchewan supervised intern teachers in Prince Albert, Saskatchewan via Anik C3. The interns in Prince Albert were equipped with a low-cost earth terminal (LCET) and could respond to their professors by long-distance telephone.

The Faculty of Education also collaborated with the Saskatchewan Teacher's Federation to produce "Teacher Talk." This program provided training information for teachers throughout the province.

"Land Alive," a four-part series geared toward farmers and animal owners and aired from 700 to 800 hours, discussed problems and issues related to farming in the western provinces. In addition, an on-campus Cropping Information Conference for Saskatchewan farmers, "Graymarket 84," was broadcast live from the University of Saskatchewan to all four western provinces via Anik C3. Four audiences were organized across Saskatchewan and directed questions back to the farmers at the conference in Saskatoon.

Various other programs produced in conjunction with Uplink 84 include three from the Faculty of Engineering of the University of Saskatchewan: "The College of Engineering Presents;" "From CAD/CAM to Robotics;" and "High Technology in Saskatchewan." The major goal of these programs was to provide the public viewing audience with information about the Faculty of Engineering's activities.

A four-part series, Appreciation of the Arts, was also produced from the University of Saskatchewan. It surveyed the areas of dance, drama, music and art.

The Arthritis Society had doctors from the medical college at the University of Saskatchewan talk to viewers about arthritis; and the Continuing Legal Education Department at the University of Saskatchewan produced programming on public legal education. In addition, programs

were prepared by the Colleges of Nursing, Physical Education and Dentistry.

One of the major achievements of this project is that it laid the groundwork for such a communications network to be instituted on a more permanent basis. The real issue that remains to be resolved is the source of financial support for continuing the service. Co-funding will be required and is being sought from outside agencies as well as through university sources.[35]

A final evaluation report of Uplink 84 is currently underway. While the project's coordinators would like to see it continued, they fear that the "Anik experimentation phase could be over."[36] This sentiment was echoed by a Telesat Canada official who queried whether there was any new work to be done in testing the technology's potential. "The technology works, what more is there to prove?"[37]

With the end of the educational experimentation phase of Canadian satellite technology possibly in sight, federal funds for educational projects may gradually evaporate to the point where universities will no longer have the means to extend their services via satellite to distance learners.

ANIK D

The two satellites in the Anik D series are designed to operate in the 6/4 GHz band. Their mission is to continue and expand the commercial services originally provided by the Anik A series. The first of the Anik D satellites was launched in August 1982 and the second is scheduled to go up in 1984. In addition to message services, Anik D is carrying CBC's Parliamentary Network in English and in French and several pay-TV channels of the Canadian Satellite Communications Corporation (CANCOM).[38]

THE FUTURE OF SATELLITES IN EDUCATION IN CANADA

The Hermes educational experiments, the Anik B pilot projects, and the ongoing TVOntario and Knowledge Network operational satellite services have made a significant contribution to extending educational services to geographically remote and distant locations. Satellite technology, pioneered in Canada, has provided people in these regions of the country with the possibility of accessing a range of alternative educational, health, entertainment and other services which were previously inaccessible to them.

There is a growing awareness among educators of the variety of distance education services which are possible using satellite technology to deliver broadcast television, both educational and commercial, to sparsely populated and remote areas. Live satellite-delivered television, when combined with audio-teleconferencing by satellite or terrestrial telephone lines, has been found to provide an effective electronic classroom for students at distant locations. As well, multimedia distance education courses using correspondence materials, television programs, teleconferencing, and computer-managed learning have been shown to be an effective means of reaching both remote and urban students.

TVOntario's NODE project is demonstrating the capability of using two-way satellite technology for providing distance education students with access to central Telidon databases. Future plans call for experimenting with "downloading" both Telidon database content and computer programs to microcomputers for storage and use locally, thus providing more cost-effective use of the satellite communications channels.

It seems reasonable to speculate that future developments in using satellites for distance education will increasingly focus on the use of computer-assisted instruction and computer-managed instruction. Satellites make it possible to distribute computer-assisted instruction courseware units from central locations to remote sites. Similarly, the interactive capabilities of computer systems make it possible to monitor the progress of students at remote locations as well as conduct computer-based testing. In addition, computers can be integrated into various local and regional

networks by satellite. Networking makes it possible to share programs and also provides the possibility of additional interactive educational services such as electronic mail and computer conferencing. Applications such as these, which use two-way satellite data channels only, have the potential to serve unlimited numbers of locations simultaneously by time-sharing a limited number of data channels. As a result, they will likely prove to be very cost-effective once they are developed operationally.

Both TVOntario and Knowledge Network have made clear commitments to using satellite telecommunications for distributing educational services throughout their respective provinces. ACCESS Alberta has plans for using satellite distribution, but to date has not initiated an operational project. Newfoundland and Quebec are also likely candidates for initiating some type of operational service in the future.

ISSUES IN THE USE OF SATELLITES IN EDUCATION IN CANADA

A study by Richmond[39] identified a number of issues which selected educators view as being major factors influencing their decisions regarding the use of satellites for educational purposes. Issues viewed as either very important or important by 100 per cent of those responding to the survey included:

- The capability of timesharing (subletting) time by an educational agency with a transponder lease to other educational and/or public service user groups;
- The need for providing for multiple services (e.g., television, telephony, computer communications, Telidon, videotex, etc.) on any satellite transponder used for educational purposes;
- The need to determine appropriate criteria for assessing student satisfaction and performance for educational services delivered via satellite;
- Determining the cost-effectiveness of any satellite-delivered educational service, and,
- Determining which types of educational services can and cannot be delivered effectively by satellite.

Ninety-five per cent of the educators responding rated the following as important issues:

- Developing methods of cost-sharing among the members of educational and/or public service user groups;
- Providing for local institutions to originate programming on any satellite educational network;
- Ownership and copyright of programs prepared for satellite distribution by individual educational institutions;
- Integrating any satellite educational service with existing terrestrial distribution systems, and,

- Using satellite delivery to extend educational services to a population not presently well served by existing educational institutions.

Three additional issues were rated as important or very important by 90 per cent of those responding:

- Establishing educational satellite consortia on a regional basis;

- Deciding whether a satellite educational service should have both broadcast (one-way) and interactive (two-way) capabilities, and,

- Deciding what type of credit transfer or advanced credit "satellite education" students should receive towards "regular" institutional programs.

These issues identify some of the more important problems which must be addressed if satellite delivery of education is to spread beyond its present, relatively limited base of services. Of major concern appear to be the areas of costs and cost-effectiveness, regulatory restrictions, and educational effectiveness.

Until just recently, only Telesat Canada, the owner of all the Anik satellites, was authorized by the Department of Communications to own satellite uplink terminals. In April, 1984 an announcement by Francis Fox, Minister of Communications, stated that effective 1 April 1986, broadcasters and businesses will also be qualified to own 12/14 GHz uplinks; and owership rights of 6/4 GHz uplinks has been extended to common carriers, such as Bell Canada and Canadian National/Canadian Pacific Telecommunications. Satellite channels remain under the jurisdiction of Telesat Canada and must be leased from them. The cost of leasing satellite channels from Telesat is prohibitive and thus excludes many potential educational users.

The use of satellites for educational purposes has progressed significantly since the first Hermes and succeeding Anik B service development projects which began in 1976. However, while the technology has matured rapidly, its educational applications are still evolving, largely through the pioneering efforts of TVOntario and Knowledge Network. New applications are being developed which emphasize the

interactive capabilities of the satellite channels. In particular, the use of two-way data channels to deliver Telidon and computer-based distance education services shows great promise.

Satellite delivery of educational services and the associated movement towards increasing use of various forms of distance education delivery is providing an impetus for change in Canada's educational systems. The availability of these new services has sparked demand for increased accessibility to quality educational programs at all levels for those persons disadvantaged by geographic isolation.

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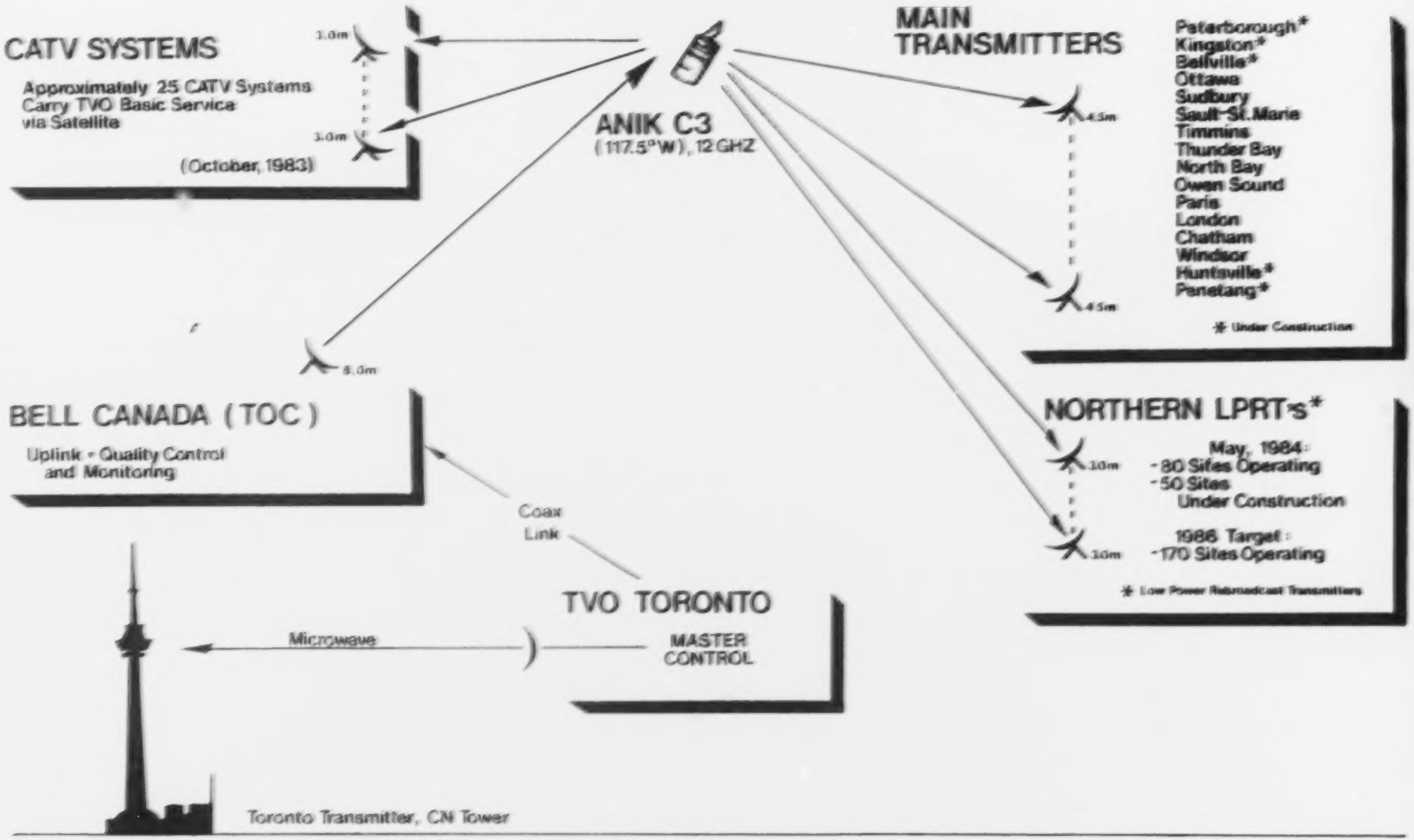
TVONTARIO
Basic Service Distribution



Source: TVOntario Engineering Branch

MAP OF CANADA, showing physical dimensions, provincial and territorial divisions and major cities.

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